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in
Single Woollen Yarns

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THE DETERMINATION OF TWIST IN SINGLE WOOLLEN YARNS

By W. J. Hall
(British Research Association for the Woollen and Worsted Industries)

SUMMARY

It was found that the twist tester investigated gave an accurate measure of the twist in single woollen yarns.

The twist actually present in a woollen yarn is considerably less than that calculated from the number of revolutions of the mule spindle, and the length of the draw.

INTRODUCTION

The determination of the turns per inch in single yarns has hitherto been very unsatisfactory on account of the low order of accuracy obtainable with the instruments ordinarily used. The results have depended so largely upon the observer's judgment that they have been of little value for single worsted yarns, and of no value whatever for woollen yarns. In a recent investigation (see Publication No. 36), a series of samples of woollen yarn were tested for strength and count. They had been spun nominally to the same count under varying conditions. When the results were analysed it was found that a simple correction could be applied to the strengths to allow for small differences in count. Now the twists were also known to vary, observations having been taken by a mechanical counter on the mule spindles. In the laboratory, however, the ordinary twist tester failed to detect the difference between two samples known to have approximately 9·3 and 13·2 turns per inch respectively. Attempts to correct the strengths for variations in twist had therefore to be abandoned until some reliable means of twist testing had been found. The ordinary twist tester has been modified by various investigators, including Dr. Oliver[1] and Professor Barker[2], with a view to making it give values for the twist independent of the judgment of the observer. Barker's modification, being readily obtainable from the instrument maker, was procured and gave satisfactory results in a preliminary trial. It was then decided to make a series of tests on mule spun woollen yarns.

EXPERIMENTAL

The first objective was to make the twist in the yarn visible so that it could be determined without the aid of any instrument. This was achieved in two ways. In the first a black and a white slubbing were passed through the delivery rollers together, the number of turns being readily counted in the resulting yarn. Since the spinning together of two separate slubbings is an operation of comparative rarity in the woollen trade, this was not pursued, as objection might be raised that it was not really representative of woollen spinning. The second method employed consisted of applying printing ink to the top slubbing delivery roller. This worked very well for yarns of 30 skeins and 18 skeins. The number of turns could easily be determined accurately to within 1%. After spinning the necessary length of marked yarn, the end was broken down and the spindle revolutions per draw of the mule were found by a mechanical counter and the length of the draw was measured. It should be noted that the twist as measured by independent means is that on the surface; the interior structure of the yarn was not investigated.

In the laboratory the twist in these marked yarns was determined by actual counting and by the twist tester as modified by Barker. The length of test-piece taken was 10 in. and the counting was done before the machine was operated. A small difficulty arises here. With the twist testing machine are supplied two weights of different sizes for the purpose of putting a tension on the yarn before screwing down the grip on the drum carrying the pointer. Now unless the tension thus put upon the yarn is equivalent to the tension in the mule immediately previous to backing off, the turns per inch observed could not be expected to agree with the value calculated from the spindle revolutions and the length of the draw. This difficulty is best eliminated in investigations on spinning by determining all the twist in a complete draw or draws, which also eliminates the effect of the unequal distribution of twist along the draw. For comparative tests of yarns for weaving this point is not so important, though it may throw light on take-up or shrinkage. This question of tension during measurement in no way affects the values by direct counting of black and white and by the machine. This comparison is shown in the Table A below.

Table A

Twist Determinations by Counting and by the Twist Tester.

(a) 30 Skeins Yarn.

TURNS PER 10-IN. LENGTH.

Counting	Tester		Counting	Tester		Counting	Tester		Counting	Tester
110	104	...	114	116	...	115	111	...	106	120
115	116	...	102	102	...	115	110	...	119	125
125	127	...	109	98	...	107	111	...	109	107
119	115	...	106	99	...	105	105	...	115	100
117	110	...	92	92	...	110	121	...	107	95
98	97	...	106	113	...	99	107	...	100	92
108	103	...	108	117	...	113	107	...	97	95
120	114	...	117	121	...	98	96	...	100	101
115	121	...	112	104	...	105	100	...	100	109
122	124	...	111	110	...	104	101	...	96	100
Totals 1149	1131	...	1077	1072	...	1071	1069	...	1049	1044
									Grand Total	4346	4316
									Average Turns per inch ...	10·86	10·79

(b) 18 Skeins Yarn.

TURNS PER 10-IN. LENGTH.

Counting	Tester		Counting	Tester		Counting	Tester		Counting	Tester
95	90	...	91	88	...	85	85	...	95	101
95	87	...	100	107	...	80	80	...	84	82
93	91	...	100	104	...	80	84	...	83	83
100	103	...	95	96	...	76	76	...	86	88
96	93	...	90	84	...	80	86	...	80	81
100	100	...	87	88	...	95	86	...	87	88
99	97	...	86	83	...	85	90	...	83	86
92	88	...	82	83	...	85	89	...	85	84
91	94	...	105	109	...	104	108	...	80	82
87	86	...	96	103	...	83	88	...	90	88
Totals 948	929	...	932	945	...	853	872	...	853	863
									Grand Total	3586	3609
									Average Turns per inch ...	8·97	9·02

The agreement is so close that the twist testing machine may be regarded as an accurate and reliable instrument. Having thus checked the accuracy of the tester, it was possible to test a number of yarns which had not been marked.

In order to compare the actual twist in the yarn with that calculated from the spindle revolutions and the length of the draw, the yarn was so manipulated in the machine that the total number of turns in three complete draws was found. The results are shown in Table B.

Table B

Comparison of Actual Turns per Draw (by Twist Tester) and Calculated Turns (from Spindle Revs. and Length of Draw).

Yarn	30 skeins	18 skeins
Net length of draw	80½ inches	76½ inches
Turns in successive 10-in. lengths ...	117 turns	84 turns
	113	76
	97	85
	109	81
	105	81
	123	89
	130	70
	128	89
	115	90
	98	80
	94	74
	100	83
	99	93
	104	94
	111	86
	120	79
	109	81
	103	89
	99	80
	98	106
	101	92
	112	—
	116	—
	32 (short piece) ...	—
Total in three draws	2533	1782
Actual turns per draw	844	594
Spindle revs. per draw	970 revs.	775 revs.

The reverse turns of the spindle in backing-off and turns in winding-on were allowed for.

To make the series of tests logically complete, the revolution counter required to be tested. This was done in the following way. The stroboscope[3] was set up to illuminate intermittently a short range of spindles on a mule. Two adjacent spindles were ultimately found which were running accurately together. The revolution counter was then placed on one of these spindles and it was found that the revolutions of the spindle were not decreased by more than 3 or 4 in 1,000. It was found, however (see the letterpress following Table C), that variations might occur, due to slip between the spindle and the counter. It may be noted that any loss in counting the revolutions would reduce, not increase, the apparent difference between calculated and actual twist.

The large difference between the spindle revolutions and the actual turns per draw in Table B was so striking that it demanded careful confirmation. It was further tested on a 30 skein yarn. Four spindles were tested on the mule, giving the following results. The tests were made exactly as in Table B, but the details are not given. Several other yarns were also tested and the results are incorporated in Table C.

Table C

Comparison of Actual Turns per Draw and Calculated Turns.

Yarn	Spindle Revs. per draw	Actual Turns per draw
30 skeins woollen	990	857
	980	868
	965	841
	960	858
33 skeins flannel	970	830
33 skeins flannel, direct spun	1347	1247
	1380	1270
33 skeins flannel, drawn and spun ...	1320	1188
	1230	1158
16 skeins (46's crossbred)	705	613
	737	650
10 skeins "homespun"	480	446

An examination of the results at the head of this table shows that the counter and twist tester do not place the four bobbins in the same order with regard to twist. This is probably because the revolution counter is less accurate than the twist tester. It is difficult to ensure that there is no slip on the spindle.

Throughout these experiments care has been taken that the results have not been vitiated by roving-off the top of the cop. It is well known that when the cop or bobbin is nearly full, several turns are usually unwound from the top while the mule carriage is coming out. This explains why the yarn from the nose of the cop is usually heavier than that from the base. The twist is also affected. For this reason, the samples of yarn tested in this work were from the lower or middle portions of the cops or bobbins.

REFERENCES

[1] Proc. Roy. Soc., Edinburgh, 1907, **27**, Part III., p. 264.

[2] Text. Recorder, 1923, **41**, No. 12, p. 95.

[3] Association Publications, Nos. 15 and 37. For the setting up and manipulation of the stroboscope, the Author is indebted to his colleague, Mr. A. W. Stevenson.